LDE
COPY
USAIGS LIBRARY
FILE COPY

INSTRUMENT
INSTRUCTIONS

U. S. ARMY ORDNANCE
FRANKFORD ARSENAL
PHILA. (37), PA.

SENSITIVE RESEARCH
INSTRUMENT CORPORATION
NEW ROCHELLE, N.Y.

Symbol of Quality

ELECTRICAL INSTRUMENTS OF PRECISION SINCE 1927

Instrument No. 803 822
REVISION 1

INSTRUCTION MANUAL

FOR

OPERATING AND MAINTENANCE

OF

LABORATORY STANDARD
ALTERNATING CURRENT VOLTMETERS

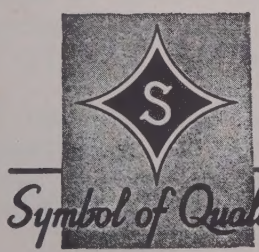
MODEL L

ACCURACY .1 of 1%

FREQUENCY RANGE

SCALE LENGTH 12 inches

TYPE Shielded Electrodynamometer



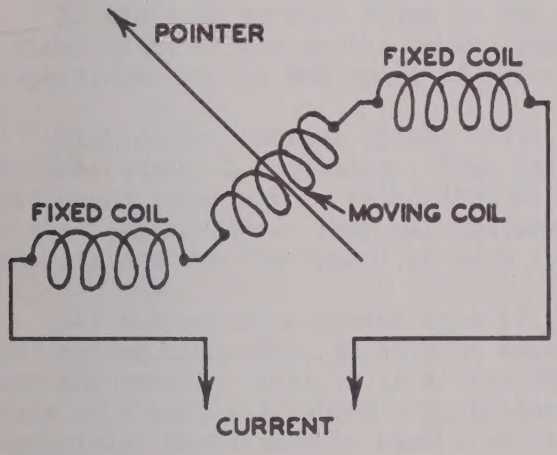
SENSITIVE RESEARCH INSTRUMENT CORPORATION
NEW ROCHELLE, NEW YORK.

ELECTRICAL INSTRUMENTS OF PRECISION SINCE 1927

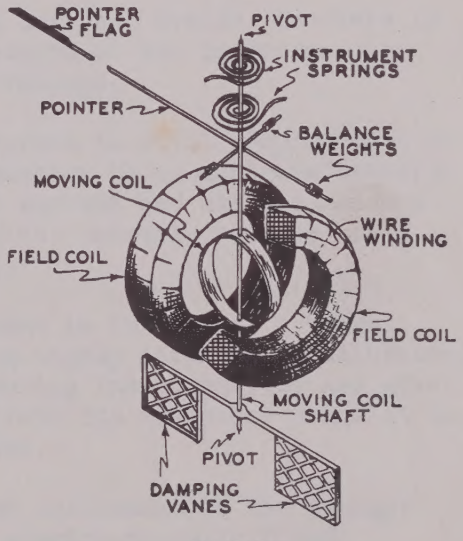
A.C. Current Measurements using a Dynamometer Instrument

The same basic principles apply to the measurement of A.C. current as to D.C. current when using the magnetic effect of the current. The A.C. current to be measured is connected to a device known as an "ELECTRO-DYNAMOMTER", which essentially is a D'Arsonval moving coil system, whose magnet is replaced by a fixed coil that carries current. The D'Arsonval iron core is not used in an electro-dynamometer (often called a "Dynamometer".)

The sketch below shows the connections of a typical "Dynamometer" when measuring current below 100 milliamperes (.1 ampere.)



BASIC DYNAMOMETER CURRENT INSTRUMENT



BASIC DYNAMOMETER MECHANISM

The turns of the fixed coils (see drawing) are equally spaced on both sides of the moving coil. The fixed coils are so connected that when current flows through the moving coil, it rotates so as to align itself with the fixed coil.

If the current, through the fixed coil is reversed (such as on A.C.) the magnetic polarity of BOTH the fixed coils and the moving coil is reversed. As the relative polarities are still the same, the moving coil rotation motion, or pointer deflection, is the same as before.

This makes this dynamometer device very suitable for the measurement of both direct and alternating current.

TECHNICAL

The instantaneous torque of the dynamometer is proportional to the product of the instantaneous magnitudes of the current, in the fixed (Field) coils and the moving coil.

The scale will NOT be linear as in a permanent magnet D'Arsonval instrument, but will be a square law scale as the PRODUCT of TWO currents is involved.

When measuring alternating current, the moving coil torque occurs in surges, two for each cycle of the current. Because the moving element has a time constant that is very long compared to the period of the alternating current, these surges of torque are mechanically averaged.

If the same current flows in the moving coil and fields, or there is a fixed ratio of one to the other, the deflection of the instrument is proportional to the RMS value of current or voltage.

With direct current in the coils, the torque is still proportional to the RMS (steady D.C.) value. Thus the dynamometer is an accurate transfer instrument which may be calibrated on direct current and used to measure alternating current. When calibrating on direct current, reverse the polarity and use the "mean" of such readings.

The electro-dynamometer type of instrument is inherently a rugged, fast acting indicator, capable of maintaining highly accurately calibrated, over the years. Since it is a true RMS measuring instrument, it has great value as a portable laboratory standard. Within its frequency range it is completely unaffected by wave form distortion.

The deflection torque of the dynamometer instrument is the average torque produced by the mutual action of the electro-magnetic fields created by current in the fixed and moving coils.

Harmonic components outside the stated frequency range of the instrument often do not cause appreciable errors in readings, since the response of the instrument does not fall off rapidly with increasing frequency. It is not recommended that frequencies below 15 cycles be measured on our standard designs. Special designs are necessary for very low frequencies. Correspondence encouraged on special problems.

MECHANICAL

A dynamometer usually does not utilize the "eddy current" damping of a direct current instrument to reduce undesirable pointer osscillation, but instead, in most cases has "air damping" because it would be inadvisable to introduce a permanent magnet near the coil.

Essentially a dynamometer movement is mechanically the same on the D'Arsonval design, that is the moving coil is mounted on a shaft pivoted at both ends. When current flows through the fields (fixed coils) and the moving coil, the moving coil rotates and tends to align itself with the fixed (field coils.)

The moving coil rotates until its torque is opposed by the torque of the two spiral, phosphor bronze instrument springs. (see drawing on the preceeding page). The current enters and leaves the moving coil through these spirally constructed springs. When the deflecting current is removed the springs cause the instrument pointer to return to its normal "zero rest" position.

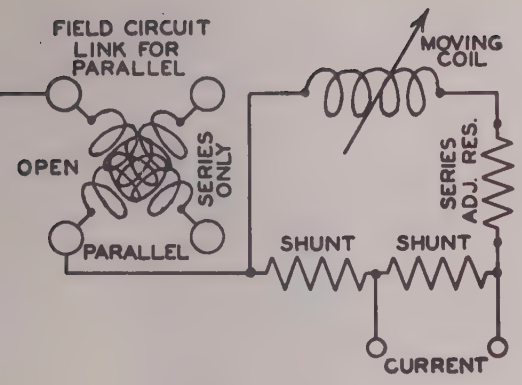
A dynamometer current instrument on direct current has NO advantage over the D'Arsonval type of D.C. moving coil because the required power consumption has been greatly increased in order to obtain a satisfactory deflection torque. A problem not facing the D'Arsonval permanent magnet moving coil system.

Due to the limitations imposed by the low torque, dynamometer instruments are not usually available with a full scale sensitivity below 5 milliamperes (.005 ampere.) This does not compare with the 1 microampere (.000001 ampere) full scale sensitivity, available with modern SENSITIVE RESEARCH D'Arsonval designs because most of the power on a D'Arsonval instrument is supplied by its permanent Magnet.

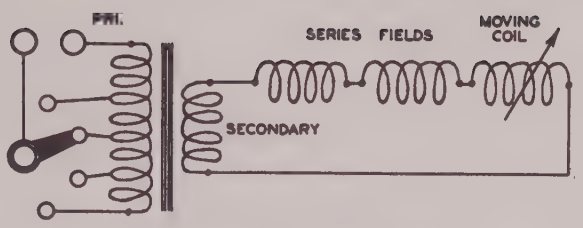
To measure currents of large magnitude a D'Arsonval (D.C.) moving coil system can be shunted, this obtaining an almost unlimited number of ranges.

A dynamometer instrument due to the complexity of A.C. current in inductive circuits cannot be shunted over very wide limits. Therefore dynamometer current instruments in general do not cover a wide range,- usually about two ranges.

Instrument transformers can be used when it is necessary to cover a wide range of currents at low or commercial frequencies.



DOUBLE CURRENT RANGE
DYNAMOMETER



INSTRUMENT TRANSFORMER
AND DYNAMOMETER

A.C. VOLTAGE MEASUREMENTS

The "dynamometer is a current measuring device but by the application of ohms law as applied to alternating current we can readily measure A.C. voltage.

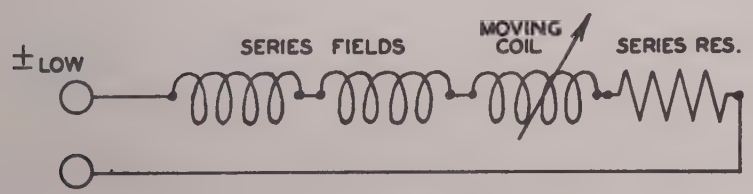
FOR EXAMPLE:

We wish to measure 75 volts alternating current at the commercial frequency of 60 cycles.

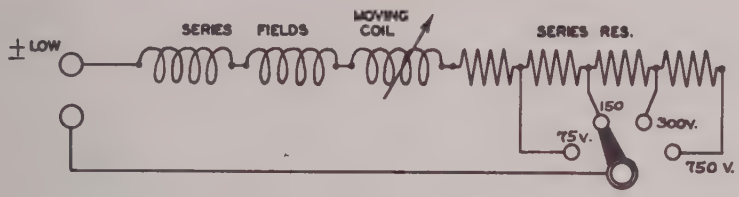
Assume our dynamometer deflects full scale for 100 milliamperes (.1 ampere.)

$$\text{THEN } R = \frac{E}{I} = \frac{75 \text{ Volts}}{.1 \text{ Ampere}} = 750 \text{ Ohms}$$

If we connect in series with our dynamometer a series resistance, such, that it will create a total circuit of 750 ohms at 60 cycles, we at 75 volts will have a current flow of .1 ampere (100 milliamperes.) We can then mark the 100 milliampere point on the scale as 75 volts. (See circuit.)



For multirange dynamometer voltmeters we use the above ohms law formula and suitable calculated values of resistance to create any desired multiranges.



CHECKING CALIBRATION

A Dynamometer is readily checked on direct current provided it is not internally connected to an instrument transformer.

A suitable source of current or voltage together with a standard instrument of at lease twice the accuracy of the dynamometer being checked is required.

The circuit controls should be smooth in current or voltage control action and be capable of very fine adjustments.

The direct current or voltage should have a reversing switch in its circuit and the "mean" of the reversed reading should be considered as the "true reading."

GENERAL INFORMATION

Upon receipt, your instrument should be carefully unpacked and examined for any visible external damage, i.e; split case, cracked glass, broken binding posts, etc. Place the instrument on a reasonably level bench. If the instrument has a wire shunting (across) the terminals, it should be removed. With the mechanical zero adjuster thumb knob, move the pointer both above and below the zero line of the scale. It should have sufficient travel to go a little beyond zero in each direction. Set the pointer exactly on zero while lightly tapping the instrument case with your fingers. The pointer will be correctly adjusted for zero when no reflection of the pointer's knife edge can be seen in the anti-parrallax mirror and the pointer is directly over and in line with the scale zero.

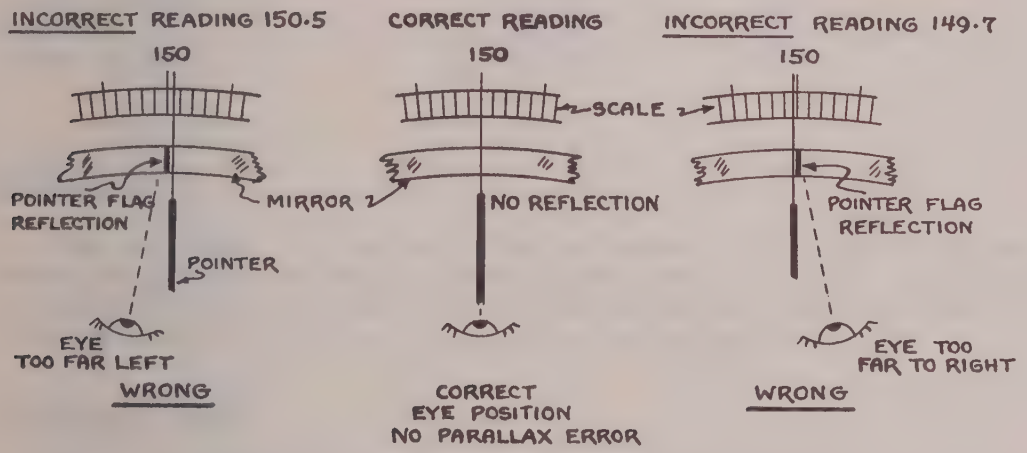


ILLUSTRATION OF THE ANTI-PARALLAX PRINCIPLE

The pointer indication should only be "read" when no reflection of its knife edge can be seen in the mirror below. This is only obtained when the eye is directly over the pointer. The drawings above illustrate the anti-parallax principle.

BALANCE TESTS FOR DIRECT CURRENT INSTRUMENTS

The general testing procedure for balance on all portable and panel instruments is the same, the difference being only in the degree of angle that the instrument is tipped from a horizontal position.

1. See that the pointer is set exactly on its zero position.

2. Now tip the instrument slowly up from the side farthest from you to an angular position as shown on the table below, and tap gently. The pointer should NOT move more than the amount shown on the table below.

3. Next, lay the instrument flat again and then tip it on its side, both left and right, and tap gently.

In both of these procedures, the instrument should be within its balance specifications. In general, these specifications are as follows:

ALTERNATING CURRENT INSTRUMENTS

MODEL	ACCURACY	ANGLE FROM HORIZONTAL	BALANCE GUARANTEE
A (ALL THERMALS)	.75 of 1%	15°	.75 of 1%
MI,D,DW, UNIVERSITY	.5 of 1%	25°	.5 of 1%
D, DLW	.25 of 1%	25°	.25 of 1%
L (LAB. ST'DS	.1 of 1%	10°	.1 of 1%

FRICTION TESTS

The instrument may be tested for mechanical friction at this point, by connecting it to a suitable source of power and deflecting it at least 25% of full scale, then reducing the deflecting current to zero. No instrument should be accepted for use if it has any appreciable friction.

CALIBRATION CHECK

No actual calibration check should be made until the instrument has become thoroughly temperature saturated at ambient room temperatures for at least four hours. (Allowed to reach room temperature.) SENSITIVE RESEARCH calibrates all instruments at exactly 25° C.

Make sure you are on the right range for your power supply. If in doubt set the range switch if any, on the instrument, on its highest range. This will prevent overloading of the instrument when starting any electrical tests. If only a slight pointer deflection results when power is applied, then successively switch the instrument range selector DOWN until a suitable reading is obtained. Bring the pointer up to full scale and open the instrument circuit. A special precaution should be taken by the user of thermocouple instruments, and that is to AVOID opening the primary circuit of a transformer whose secondary circuit is being measured by thermocouple instruments. The reason for this is that the transformer as an energy storing device, may, under certain conditions, DISCHARGE its energy into the secondary circuit, thereby overloading the thermocouple instrument. (Overloads of 1000% are quite possible in transformer circuits.)

This danger can be eliminated by either disconnecting the instrument from the secondary circuit which can be turned to "zero" so that the excitation of any transformer primary may be reduced to "zero" before switching off.

The pointer should return to its original zero without tapping. If it returns to zero only when tapped, it indicates friction in the movement and possible damage to the pivots and jewels, possible through some severe shock in transit. For portable instruments with an overall accuracy of .5 of 1% or higher, and all high torque panel types, the pointer should return to exactly zero. Ultra high sensitivity instruments in the 1% class, and thermocouple instruments in the .75 of 1% class should have a maximum deviation from zero to no more than .1 of 1% of the physical length of the scale.

The pointer should then be deflected using controlled power slowly up and down the instrument scale. The pointer action should be smooth and there should be no sticking or hesitation at any point on the scale. Do not, however, mistake a rough spot in the controls of your power supply for a "stick" in the movement. Often, a badly regulated power supply or a loose circuit connection may make the instrument appear to have an internal variable. All instrument links and leads should be carefully attached and tightened.

The new instrument should be checked against an accurate standard on the cardinal points of the scale. Jus one word of CAUTION. Be careful that you do not place your new instrument and your standard too close together, especially with D.C. instruments. They may react magnetically on each other if your standard instrument is not magnetically shielded, it might indicate incorrect readings. Keep them at least six inches apart. Also, if the instrument was specially ordered for use on a steel panel (such information is printed on all our scales) then test it on a steel panel of the specified thickness.

Of all the things, that may be wrong when you get a new instrument, incorrect calibration is the LEAST likely; and if present at all, it will usually be caused by bad balance which you will already have detected by the test just covered. 99.99% of the instruments you receive, if they are satisfactory for balance, friction, stickiness etc., will also be well within their guaranteed accuracy.

NOTE:

Disassembly of the movement should not be attempted unless a skilled instrument man with calibration and scale drawing equipment are available.

E AND MAINTENANCE

All SENSITIVE RESEARCH instruments are individually assembled by lled instrument makers and are INDIVIDUALLY calibrated. We do not ibrate instruments "en masse". Extreme care has been used in ecting pivots and shock mounted jewel bearings. In some instruments MOND PIVOTS are used.

The instrument should be used and treated as a precision standard. easonable amount of care will bring its reward in a lifetime of accurate vice.

Good practice dictates that periodic checks be made for pivot friction, l, balance, scale calibration, and the mechanical integrity of any trument.

If the instrument glass is cleaned by any method, the task should be pleted by heavily breathing upon the glass so as to dissipate any ctrostatic charges that may have been generated by friction. Occasionally binding posts metal contact surfaces should be cleaned and brightened by careful use of a fine sandpaper. A yearly coat of wax on any wooden trument case is suggested.

Instrument panels are cleaned by using carbon tetrochloride to dissolve greasy surface accumulations. A brisk rubbing with a soft flannel cloth l restore our moulded panels to their original lustre. Should the engraving ite" become discolored it can be removed with a sharp point and refilled h a white wax crayon material obtained from us.

OPERATIONAL PROCEDURE

1. Place the instrument on a level surface so that the scale is horizontal. Deviations of more than 5° from the horizontal may affect accuracy adversely.

2. For good instrument practice, the instrument should be kept away from any source of very strong magnetic fields. Maximum tolerable field is 5 oersted.

3. Set the pointer on zero by rotating the zero shifter, using thumb or zero screw. The pointer is correctly set on zero when the reflection of the pointer in the antiparallax mirror coincides with the pointer itself and with the zero line. (See general information sheets.) Page 4

4. For safety it is best to turn off the current or voltage to be measured before making connections to any instrument. Observing proper polarity, connect the instrument terminals in series with the circuit if current is to be measured.

   If voltage is to be measured then the voltmeter is to be in parallel to the portion of the circuit desired. It is important to remember that when an ammeter (current measuring instrument) is inserted in series with a circuit, the circuit is changed by the introduction of the ammeter resistance. Ammeters are therefore designed to be of low resistance so that they will only be a small fraction of the total resistance of a circuit.

   Remember also that when a voltmeter is connected across (in parallel) with a portion of a circuit it changes the potential difference by its own effect on the circuit and since it also is connected in parallel with a part of the circuit it reduces the effective resistance of that portion which increases in some degree the total current flowing in the complete circuit.

   Therefore voltmeters are designed to have the highest resistance possible so as not to change materially any circuit to which they may be applied.

5. It is considered good instrument practice in multirange instruments to have the range switch on the highest possible range and then the user can progressively switch down to the range that produces an acceptable reading. A good acceptable reading would be one in which the pointer is indicating in the upper fifth of the scale. (Nearly maximum deflection.) Apply power and observe pointer deflection. When the instrument pointer has come to rest, the current is indicated by the position of the pointer on the scale.

6. After the desired measurements have completed, turn off the current supply and disconnect the instrument terminals from the source of current. If the instrument leads are left connected and circuit changes made damage could result to the instrument being on a range setting lower than the newly applied power value.

SENSITIVE RESEARCH INSTRUMENTS have a data card attached to it or mounted in its case. This data card detailing the accuracy and electrical characteristics together with the instrument panel engraving will readily enable the user to operate our instruments to their full accuracy and their personal satisfaction.

SENSITIVE RESEARCH INSTRUMENT CORP. 310 MAIN STREET, NEW ROCHELLE N.Y., U.S.A.

SPARE PARTS LIST

MODEL SECTION

CUSTOMER CONTRACT NUMBER

ITEM NUMBER	PART NUMBER		DESCRIPTION	S.R.I.C. WILL REPAIR / CUSTOMER CAN REPAIR	PIECES PER ASSEMBLY	PIECE PRICE
	CUSTOMER PART NO.	S.R.I.C. PART NO.				
			WOODEN CASE PARTS - MODEL "L"			
1		SR#LB-2	Model "L" case (Deep). No cover		1	$32.00
2		SR#3301	Model "L" molded bakelite panel		1	22.00
3		SR#L-200	Electropane panel glass		1	6.00
4		SR#L-201	Felt gasket for panel glass		1	1.00
5		SR#901	Heavy mirror		1	25.00
6		SR#L-180	Instrument scale		1	10.00
10		SR#518	Panel glass clips		5	.15
11		SR#2112	Zero screw and sleeve		1	4.50
12		SR#322	Zero friction washer		1	.25
13		SR#506	Zero cam and pin		1	2.25
14		SR#LE23	Level		1	2.65
15		SR#L-150	Binding posts - Model "L" complete with washers and nut.		2	1.00
20		Standard	Washers #10		2	-
21		Standard	Split washers #10		2	-
22		Standard	Nuts 10/32		2	-

SPARE PARTS LIST

MODEL SECTION

CUSTOMER CONTRACT NUMBER

ITEM NUMBER	PART NUMBER		DESCRIPTION	S.R.I.C. WILL REPAIR / CUSTOMER CAN REPAIR	PIECES PER ASSEMBLY	PIECE PRICE
	CUSTOMER PART NO.	S.R.I.C. PART NO.				
			MODEL "L" WOODEN CASE PARTS (CONTD)			
21		Standard	Nuts 10/32			
22		SR#LB20	Bakelite baseplate		1	$22.00
23		SR#LB30	Mirror pillars 3.7/16"x1/2"		6	2.50 ea
24		SR#LB31	Carcass plate pillars 3/4"x5/16"		4	2.50 "
25		SR#LB32	Carcass plate		1	7.50
26		SR#LB33	Magnetic shield		1	20.00
30		SR#LB50	Corner case studs		4	1.75ea
31		Standard	Fillister head screw 3/8" - 6/32		1	
32		Standard	Fillister head screw 1/8" - 4/36		3	
33		Standard	Flat head wood screw 7/8" - #10		6	

STANDARD - Readily obtainable.

SENSITIVE RESEARCH INSTRUMENT CORP. 310 MAIN STREET, NEW ROCHELLE N.Y., U.S.A.

SPARE PARTS LIST

MODEL SECTION

CUSTOMER CONTRACT NUMBER

ITEM NUMBER	PART NUMBER		DESCRIPTION	S.R.I.C. WILL REPAIR	CUSTOMER CAN REPAIR	PIECES PER ASSEMBLY	PIECE PRICE
	CUSTOMER PART NO.	S.R.I.C. PART NO.					
			MULTIPLIER FOR USE WITH MODEL				
1		Mult.20	Wooden case for multiplier to be used with Model			1	$26.50
2		Mult.10	Molded bakelite panel for multiplier 12.7/16"x14.1/2"x1/2"			1	10.00
3		Mult.	Binding posts				
4		Mult.21	Case corner studs - 3/16"x6"			4	1.75ea
5		Mult.22	Rubber feet (large black) 1"			4	.75ea

SENSITIVE RESEARCH INSTRUMENT CORP. 310 MAIN STREET, NEW ROCHELLE N.Y., U.S.A.

SPARE PARTS LIST

MODEL SECTION

CUSTOMER CONTRACT NUMBER

ITEM NUMBER	PART NUMBER		DESCRIPTION	S.R.I.C. WILL REPAIR / CUSTOMER CAN REPAIR	PIECES PER ASSEMBLY	PIECE PRICE
	CUSTOMER PART NO.	S.R.I.C. PART NO.				
			MOVEMENT PARTS			
1		SR#911	Bridge upright		2	$9.00) pair)
2		SR#903	Field clip		2	.20
3		SR#921	Dynamometer bridge		2	
4		SR#910	Field connection plate		1	1.00
5		SR#918	Field connection lugs		4	.20ea
10		SR#415	Pointer stop screw (card 3/32" - 80 shoulder screw)		2	.30ea
11		SR#420	Pointer striker (glass)		2	.20ea
12			Bottom bridge assembly		1	
13			Top bridge assembly		1	
14		SR#709B	Model DW spring mounted jewel - Bottom jewel		1	3.50
15		SR#709	Model DW jewel screw - hard jewel - top jewel		1	2.50
20			Instrument moving coil assembly complete with pointer, pivots, springs and moving coil. Important - When ordering moving coil it is requested that you give the instrument number if possible.			47.00

SENSITIVE RESEARCH INSTRUMENT CORP. 310 MAIN STREET, NEW ROCHELLE N.Y., U.S.A.

SPARE PARTS LIST

MODEL SECTION

CUSTOMER CONTRACT NUMBER

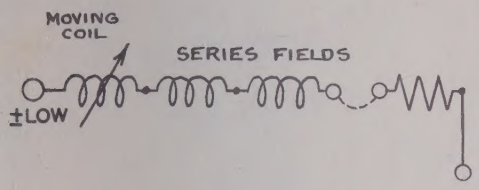
ITEM NUMBER	PART NUMBER		DESCRIPTION	S.R.I.C. WILL REPAIR / CUSTOMER CAN REPAIR	PIECES PER ASSEMBLY	PIECE PRICE
	CUSTOMER PART NO.	S.R.I.C. PART NO.				
			MOVEMENT PARTS (CONTD)			
21		DP700	Diamond pivots		2	$15.00ea
22		SR#U-411	Bridge lug		2	.10 "
23			Field - Stationary		2	15.00)
			Important - When ordering stationary field it is requested that you give the instrument number if possible.			pair)

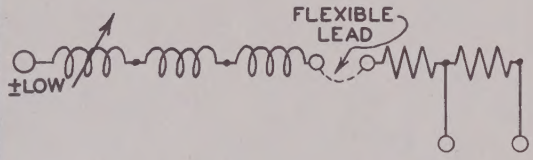
SPECIFICATIONS & SCHEMATIC DIAGRAMS
OF

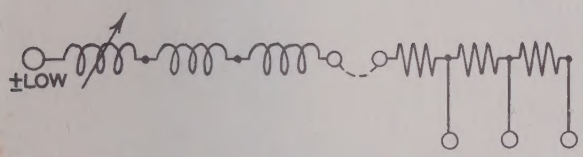
LABORATORY STANDARD DYNAMOMETER VOLTMETERS

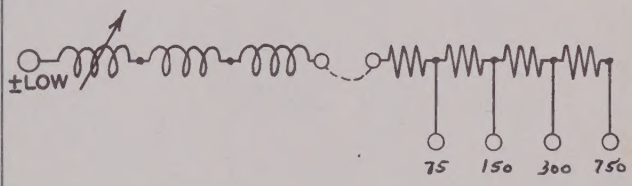
TYPE LAB STANDARD
MODEL L INSTRUMENT Nº 803822
CODEWORD LABVOS
RANGES 0-75/150/300/750V
SEE DIAGRAM Nº ④

SPECIAL FEATURES

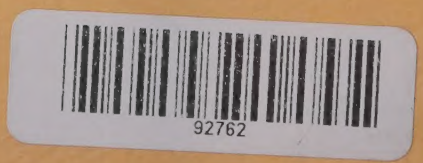








[153] SRICO BY L J Patten DATE 1/27/58


92762